



UNIVERSITÉ DE GENÈVE



NLR-Memorandum AMSTR-NLR-PR-078-Issue 1.0
CO2 end cap and pinch leaktest Procedure

National Aerospace Laboratory (NLR)

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Summary

For the AMS experiment onboard the International Space Station a thermal control system, known as the Tracker Thermal Control System (TTCS) is being developed. The TTCS basically consists of a mechanically pumped two-phase loop, where heat is collected at two evaporators and rejected at two radiators. The loop contains carbon dioxide. Critical parts of the loop are protected against freezing, using thermostats and heaters.

The TTCS is filled by CO₂ via a fill tube. This fill tube has to be sealed after filling. To check the leak rate after the filling the amount of CO₂ leaking from the fill tube is being measured with a mass spectrometer.

This document describes the plan and procedure for the CO₂ leak rate measurement of the fill tube.



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(14 pages in total)



1 Introduction

2 Reference documents

Ref	Author(s)	Title
1		
2		

3 Items under test

The items under test comprises

4 Test objectives and criteria

4.1 Objective

Verify the end cap and pinch leak is lower than the requirement.

4.2 Procedure in main steps

1. Perform measurement on air CO₂ concentration (health check mass spectrometer RGA)
2. Perform zero measurement on gN₂ (off-set/nulling)
3. Perform background measurement of measurement set-up with glued plastic flanges
4. Perform background measurement of measurement set-up on plastic flanges with O-rings
5. Perform on-line measurement with O-rings

In case the measurement with O-rings is not successful the flanges will be glued to the inlet tube (and of course removed afterwards).

5 Test procedure sheets

	TTCS CO2 leak test		company: NLR		date:	
	Fill in by hand.		engineer:		location:	
Step	Action	Monitoring	Value	Result	Comment	✓
1.	Record TTCS	T.I. description	-			
2.	Record model (EM / QM / FM)	Model	-			
3.	Record RGA equipment used	Manufacturer, type s/n	-			
4.	Record pressure sensor used	Manufacturer, type s/n	-			
5.	Record multimeter used	Manufacturer, type s/n	-			
6.	Record ambient pressure with equipment mentioned above	Ambient pressure				
7.	Record ambient temperature	Temperature	-			
8.	Record relative humidity	Relative humidity	-			

TTCS CO2 leak test		company: NLR		date:		
Fill in by hand.		engineer:		location:		
Step	Action	Monitoring	Value	Result	Comment	√
9.	REFERENCE MEASUREMENT ON TEST FILL TUBE (OFF-LINE) (PLASTIC FLANGE GLUED)					
10.	Set up the CO ₂ leak test set-up with a test fill tube.					
11.	Make a picture of the CO ₂ leak test set-up as reference. Store picture in V:\jvanes\Projects\AMS-Tracker\documents\Procedures\AMSTR-NLR-PR-078_CO2_leak_detection_procedure					
12.	Flush the accumulation volume and the intermediate volumes with gN ₂ for at least 15 minutes to reduce the CO ₂ concentration	Accumulation time	15 minutes or more			
13.	Set zero correction off	Zero correction setting	Off			
14.	Perform a measurement on ambient air with the RGA (Mass spectrometer)					
15.	Store the ambient air measurement	ppm				
16.	Check the CO ₂ concentration of step 14	CO ₂ concentration	400 ppm			
17.	Close the accumulation volume with the 3-way valve and the accumulation outlet valve. Record time and start accumulation time	Time				

TTCS CO2 leak test			company: NLR		date:	
Fill in by hand.			engineer:		location:	
Step	Action	Monitoring	Value	Result	Comment	✓
18.	Connect the RGA to the measurement set-up					
19.	Start measuring on a gN ₂ flow with the RGA (mass spectrometer)					
20.	Make pictures of the CO ₂ leak verification measurement set-up. Store pictures in: V:\jvanes\Tracker\documents\Procedures\....					
21.	Wait 55 minutes from start of accumulation time	Accumulation time – 5 minutes	55 minutes			
22.	Perform a zero measurement with the RGA					
23.	Set CO ₂ Ion current in the zero file	Ion current				
24.	Set zero correction on	Zero correction setting	On			
25.	Measure the pressure in the accumulation volume	Absolute pressure [mbar]	Ambient pressure + 0.06 +/- 0.00 mbar			
26.	Wait for end of accumulation time	Accumulation time	60 minutes			

TTCS CO ₂ leak test		company: NLR		date:		
Fill in by hand.		engineer:		location:		
Step	Action	Monitoring	Value	Result	Comment	✓
27.	Perform the CO ₂ concentration measurement with the RGA	CO ₂ concentration	About 20 ppm			
28.	Store CO ₂ concentration measurement	Measurement name				
29.	Connect the RGA to a gN ₂ filled volume					
30.	Measure the accumulation volume of the test setup.	Accumulation volume [ml]				
31.	Dry the test set-up.					
32.	END OF REFERENCE MEASUREMENT OFF-LINE (PLASTIC FLANGE GLUED)					
33.	REFERENCE MEASUREMENT ON TEST FILL TUBE (OFF-LINE) (PLASTIC FLANGE WITH O-RINGS)					
34.	Set up the CO ₂ leak test set-up with a test fill tube.					
35.	Put some vacuum grease on the O-rings and test fill tube					
36.	Make a picture of the CO ₂ leak test set-up as reference. Store picture in V:\jvanes\Projects\AMS-Tracker\documents\Procedures\AMSTR-NLR-PR-078_CO ₂ _leak_detection_procedure					

TTCS CO ₂ leak test			company: NLR		date:	
Fill in by hand.			engineer:		location:	
Step	Action	Monitoring	Value	Result	Comment	✓
37.	Flush the accumulation volume and the intermediate volumes with gN ₂ for at least 15 minutes to reduce the CO ₂ concentration	Accumulation time	15 minutes or more			
38.	Set zero correction off	Zero correction setting	Off			
39.	Perform a measurement on ambient air with the RGA (Mass spectrometer)					
40.	Store the ambient air measurement	ppm				
41.	Check the CO ₂ concentration of step 14	CO ₂ concentration	400 ppm			
42.	Close the accumulation volume with the 3-way valve and the accumulation outlet valve. Record time and start accumulation time	Time				
43.	Connect the RGA to the measurement set-up					
44.	Start measuring on a gN ₂ flow with the RGA (mass spectrometer)					
45.	Make pictures of the CO ₂ leak verification measurement set-up. Store pictures in: V:\jvanes\Tracker\documents\Procedures\....					
46.	Wait 55 minutes from start of accumulation time	Accumulation time – 5 minutes	55 minutes			

TTCS CO2 leak test			company: NLR		date:	
Fill in by hand.			engineer:		location:	
Step	Action	Monitoring	Value	Result	Comment	√
47.	Perform a zero measurement with the RGA					
48.	Set CO ₂ Ion current in the zero file	Ion current				
49.	Set zero correction on	Zero correction setting	On			
50.	Measure the pressure in the accumulation volume	Absolute pressure [mbar]	Ambient pressure + 0.06 /- 0.00 mbar			
51.	Wait for end of accumulation time	Accumulation time	60 minutes			
52.	Perform the CO ₂ concentration measurement with the RGA	CO ₂ concentration	About 20 ppm		Background level for CO2 leak test	
53.	Store CO ₂ concentration measurement	Measurement name				
54.	Connect the RGA to a gN ₂ filled volume					
55.	Measure the accumulation volume of the test setup.	Accumulation volume [ml]				
56.	Dry the test set-up.					

	TTCS CO2 leak test		company: NLR		date:	
	Fill in by hand.		engineer:		location:	
Step	Action	Monitoring	Value	Result	Comment	√
57.	REFERENCE MEASUREMENT ON TEST FILL TUBE (OFF-LINE) (PLASTIC FLANGE WITH O-RINGS)					
58.	START ON-LINE MEASUREMENT					
59.	Position the plastic flange on the fill tube at 5 mm from the pinch	Distance from pinch	5 +/- 3 mm			
60.	Reduce the leakage between the fill tube and the plastic flange					
61.	Set up the CO ₂ leak test set-up on the fill tube.					
62.	Put some vacuum grease on the O-rings and fill tube					
63.	Flush the accumulation volume and the intermediate volume with gN ₂ for at least 15 minutes to reduce the CO ₂ concentration	Accumulation time	15 minutes or more			
64.	Close the accumulation volume with the 3-way valve and the accumulation outlet valve. Record time and start accumulation time	Time				
65.	Connect the RGA to the measurement set-up					
66.	Set zero correction off	Zero correction setting	Off			
67.	Start measuring on a gN ₂ flow with the RGA					

TTCS CO2 leak test		company: NLR		date:		
Fill in by hand.		engineer:		location:		
Step	Action	Monitoring	Value	Result	Comment	✓
68.	Make pictures of the CO ₂ leak measurement set-up. Store pictures in: V:\jvanes\AMS-Tracker\documents\Procedures\....					
69.	Wait 55 minutes from start of accumulation time	Accumulation time – 5 minutes	55 minutes			
70.	Perform a zero measurement with the RGA					
71.	Set CO ₂ Ion current in the zero file	Ion current				
72.	Set zero correction on	Zero correction setting	On			
73.	Measure the pressure in the accumulation volume	Absolute pressure [mbar]	Ambient pressure +0.06 /- 0.00 mbar			
74.	Wait for end of accumulation time	Accumulation time	60 minutes			
75.	Perform the CO ₂ concentration measurement with the RGA	CO ₂ concentration				
76.	Store CO ₂ concentration measurement	Measurement name				
77.	Perform a measurement on ambient air with the RGA.	CO ₂ concentration	400 ppm			

	TTCS CO2 leak test		company: NLR		date:	
	Fill in by hand.		engineer:		location:	
Step	Action	Monitoring	Value	Result	Comment	√
78.	Store the ambient air measurement	Measurement name				
79.	Record ambient pressure with equipment mentioned above	Ambient pressure				
80.	Record ambient temperature	Temperature				
81.	Check if the CO ₂ concentration of step 75 is lower than the allowed CO ₂ concentration. The allowed CO ₂ concentration = measured accumulation volume of step 30 in ml * average ambient pressure of step 6 and 79 * (measured CO ₂ concentration of step 27 plus 30 ppm)/(255 ml*1.03 mbar)	CO ₂ concentration of step 75	Allowed CO ₂ concentration.			
82.	Remove plastic flanges and O-rings from fill tube					
83.	Clean inlet tube with IPA/remove vacuum grease					
84.	End of procedure					